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An Article on "Artifact of Bicycle & Bakelite" Theory- Social Construction of Technology (SCOT) with the theme of Technology and Society

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INTRODUCTION

Technologies or innovations for example we can say wheel, computer, mobile, bicycle etc. All of these shapes and organize the world as well as our lives.

To illustrate the SCOT analysis, we can use the case of the social construction of the safety bicycle in the late nineteenth century (Wiebe Bijker,1987). Major changes have taken place over the last decade in the world of bicycles. These changes point to short comings in Pinch and Bijker's analytical framework. In particular, SCOT looks closely into the workings of technology, its account of society doesn't allow a sufficiently complex understanding of exactly how it is that social features come to be built into technological artifact (Wiebe Bijker,1987).

The theory of social construction of technology (SCOT), also known as technological determinism, applies to how we are able to interpret the bicycle from both a historical and modern standpoint. The "interpretative flexibility" inherent within this theory stands for a group-dependent lens of analysis (Lohan, M.2000). Bijker touches specifically on the example of the air tire and how the advancement of this element was viewed by various users—the racers were concerned about speed, others appreciated its convenience and stability while producers were focused on economic outcomes. "Relevant social groups do not simply see different aspects of one artifact. The meaning given by a relevant social group actually constitutes the artefacts" (Brown.edu, 2018).

The Importance of Social Structure & SCOT ?

The difficulties with approach favoured in SCOT fall into two broad categories: method and explanation. As elaborated by Bijker (1995), method consists to identify the set of relevant social groups. One problem with this method is that of completeness. A simple comparison of Pinch and Bijker's (1987) analysis of the development of the bicycle with Bijker's (1995).

Pinch & Bijker's original exposition of SCOT includes the objective of bringing together the micro-level of the technological content of artefacts with the macro-level of the wider society in which these are located. Ironically, the SCOT framework obstructs this possibility by establishing an untenable distinction between the micro and the macro - that is, between a technology's interpretive flexibility and the mechanisms of its stabilization on the one hand, and its wider social context on the other (Rosen, 1993). With the case of mountain bikes, there are number of implications this approach has for our understanding of the social shaping of technology (Rosen, 1993).

Social Construction of Technology (SCOT)

Social Construction of Technology In general, the social construction of reality (which is later applied on technological development) is a social theory that claims that humans grasp the world using the shared assumptions about the reality with the shared assumption standing for the reality itself. The basic theoretical background for understanding the constructivist viewpoint on technology is presented in below Section 1.1.

The Social Construction of Technology (SCOT) is a well-established sociological theoretical framework applying these ideas to the technological world. While talking about technological innovations, it is easy to immerse deeply in the technological nature of the innovations. Unlike the shared beliefs of decades, investors, consumers, etc., the technical details of the inventions are usually well-documented and if needed can be replicated at any time. While ignoring social context of the inventions, one can fall in a groundless surprise how the technology stunningly influenced the society, even though it may have been the social, political or economic environment that reinforced technological change itself. The Social Construction of Technology tries to provide a methodology to avoid such ways in understanding the technological development. I tried to describe the theory in a summarized way in Sections 1.2 and 1.3.

Theoretical Background on Social Construction of Reality

The social construction of reality is sociological theory that was introduced by a book of the same name by Berger and Luckmann (1966). The main question the theory attempts to answer is: how do people attribute meaning in their everyday life? In the reality of everyday life, people take most of the concepts, events. Their meaning is not considered problematic at all. Practical use of everyday terms does not need to consider edge cases, does need to resolve inconsistencies if they do not collide with the practical use. This meaning can transcendent to the reality of theoretical thinking only with the difficulties. Science often deals with this problem by postulating theoretical concepts which stand outside of everyday reality (e.g., mathematical concept of set), another way can be seen often in philosophy which problematize the everyday concepts beyond their everyday use. When sociology wants to study social phenomena of everyday reality, it needs to conduct theoretical thinking over concepts of everyday reality which are not suitable for this purpose. For example, the notion of freedom as vaguely understood by most of the society members will be certainly different from a rigorous result of a thorough philosophical reflection of the notion of freedom (Rust, 2006). The theory of social construction reality overcomes this strange dichotomy meaning by institutionalization of social phenomena, how they are known and how this knowledge is passed in the society. These can be rigorously described and thus provide a solid foundation for further theoretical work. Objects in everyday reality have a meaning for us when they declare subjective intentions. For instance, a weapon always expresses a general intent to commit violence and does it in an intersubjective way- for everyone who knows how a weapon look like and what it can be used for. This is possible due to types of its use. On top of objects which express subjective intentions directly, there are special objects which are called symbolic signs (Libovicky, 2016). A sign is something that carries subjective intention, which is typical but independent on immediate situation (it is possible to threat someone without showing an actual weapon, by just using words). Most of human activity usually get habituated, for example repeated activities eventually become patterns. The evident practical psychological advantage of habituation is that we do not need to re-invent everything when we do it and gradually get better in the activities. Mutual type of habituated activities is called institutionalization. Social institutions emerge during the shared history, set normative patterns of human behaviour and apply social control on it. It can be illustrated on a simple example of a Parents and their children. When a childless couple decides they will organize their everyday life in a particular way, their decisions are already a potential social institution. They know that they agreed on that and that they can change it any time (Rust, 2006). The same process happens in much larger scale in the whole society. Keeping together a society with many diverse groups living in different every day realities requires a value framework in which existence of the other groups is legitimate. In below section we can see constructivist viewpoint on technology.

Constructivist Viewpoint on Technology

Thomas Kuhn starts his Structure of Scientific Revolutions (Kuhn, 1970) by the following thought: how it is possible that so many Aristotle's ideas are still valid nowadays, whereas his opinions on physics or biology seem to be naive or even stupid. These thoughts led him to inventing a notion of scientific paradigm and introducing his theory of scientific revolutions. Maybe these were similar thoughts that led Wiebe Bijker to develop his theory of social construction of technology. Having lived in the Netherlands, he must have been surrounded by bicycles and thought how was it possible that even though the technological means necessary for constructing a modern bicycle were available for merely half a century, it took until the beginning of the 20th century before the modern bike became a device usable as a means of everyday transportation (Bijker, 1997). In a book Of Bicycles, Bakelites, and Bulbs (Bijker, 1997), it became a prototypical case of how social, political and economic aspects influence the technology as much as the technical aspects. The Social Construction of Technology is a conceptual framework that started its development in the late 1970s as a critical reaction on so called technological determinism (Bijker, 1997). Technological determinism assumes that technology develops autonomously, having its own internal logic and it is therefore the technology influences to a great extend the social development. A famous example of this approach is work of Marshall McLuhan, who was able to explain in this manner many important moments of history of human communication and demonstrate how the technological innovation in human communication had fundamentally changed the way the western world worked (McLuhan, 1964). The limitations of the deterministic view arise clearly when we start to ask questions like: was the Space Shuttle Challenger disaster in 1986 primarily a technical failure, an organizational mistake or a lack of funding (Bijker, 2010; Vaughan, 1997)? At the first sight, it may seem it was indeed a technological failure because it was the technology what failed. When this is analysed more thoroughly, it becomes obvious that none of the suggested reasons is the primary one and that all the mentioned factors form a 'seamless web' (Bijker, 1997) of mutually interconnected relevant aspects. Along with underestimating the role of political and economic environment, there is another political risk that can follow from technological determinism. The assumption that world of technology is constituted by expert knowledge of the technologists, firmly rooted in the objective world and therefore can be a source of "objective" policy-making advice (Bijker, 2006), disregarding any implicit ideology driving the technological development. SCOT applies the constructivist twist in sociology of technology. If we silently assume contemporary meaning and values attributed to technology together with universally valid objective engineering conceptualization of the technology development, the fact people did not invent a modern bicycle fifty years earlier is indeed understandable. In order to find out why that happened, we should focus less on the technological side of the problem and take into account values that were attributed to the technology during its development (Libovicky, 2016). However, from the theory of social construction of reality, we already know they can be captured by the process of institutionalization of the technology use and other social phenomena associated with the technology.

Conceptual Framework of SCOT

From what was just said, it appears that term technology in the conceptual framework of SCOT includes not only the technology artefacts and technological systems themselves,

but also the knowledge about them and the practices connected with them. The theory distinguishes four levels of analysis: a singular artifact, a technological system, a socioecological ensemble and technological culture. By trying to come up with a formal definition of these concepts (as in case of any other concepts), I would end up with complicated definitions with a long discussion on edge cases. For simplicity, I only illustrate the levels by describing typical phenomena that belong to the particular levels of analysis. A singular artifact is a technological product, no matter whether a product invention (e.g., bicycle, smart phone) or a process invention (e.g., Bakelite, deep learning). The subject of study is a story of how a singular machine or a process is socially shaped. The key concepts the SCOT works with are the 'relevant social groups' and 'interpretative flexibility'. A relevant social group is any social group that attributes a meaning to the technology. Although, a membership in the groups can massively overlap, every relevant social group in fact sees actually a different artifact than the others. If we follow the example provided by Bijker (1997), for the high-wheeled bicycle that was common in the 1870s there were at least four relevant social groups:

1. bicycle producers who wanted to make profit on the bicycle production,
2. young athletic men who wanted to show off themselves,
3. women bikers who faced gender discrimination because they could not wear proper clothes while riding a bicycle, and
4. conservative moralist who has seen bicycles as an eccentric and dangerous thing.

The existence of parallel interpretations is called 'interpretative flexibility'. The later phases of the artifact development when it reaches a stable design are called 'stabilization' and 'closure'. At these phases, the artifact development can be narrated as a linear path of consecutive, mutually undermined inventions leading to the artefact (Bijker,1997). Bijker (1997, p. 271) claims that after the closure, the history gets immediately rewritten. In the case of bicycles, this was reached by introducing the so called 'safety bicycle' whose design is stable since a century ago. This builds up a 'technological frame.' These terms can be seen as analogical Kuhn's conceptualization of scientific development. The 'technological frame' corresponds to Kuhn's 'normal science' and 'closure' to the moment when an 'alternative paradigm' becomes the dominant one (Bijker, 1997).

Stabilization of the technological frame can be illustrated also on more recent examples. Few years ago, there were competing concept of touch screen smart phone and Blackberry smart phones with a physical QWERTY keyboard. Although at some point, the Blackberry phones were very popular. In the UK, they were so popular that they were attributed a crucial role in the 2011 London riots (Halliday, 2011). Having one these days would seem ridiculous. The concept of 'technological system' goes beyond the artifact and except the technical elements, it comprises the social, organizational, economic and political issues as well. When a technology grows, more a more capital, more technology and business effort are invested in its development—this builds up 'technological momentum' which is the most important phenomenon on the system level. The bigger the momentum is, the harder is changing the course of the development. A good example of an unstoppable momentum is why we still use QWERTY keyboards despite the original technological motivation for this layout is no longer valid (Bijker, 2006, p. 29).

A 'sociotechnical ensemble' is a similar concept to a 'technological system', again considering a broader social context.

History of the bicycle

The history of the bicycle is so fraught with unknowns and confusion that a yearly Bicycle History conference is held in attempt to clarify these details. Currently in its 15th year, I think some progress has been made.

1818- the dandy horse or "running machine" invented by Karl von Drais This contraption was propelled by the rider pushing himself along with this foot on the ground. Lacking pedals, a steering mechanism and brakes, it was difficult and even dangerous to manoeuvre.

1850- First three-wheeler, allowing for a more stable ride.
1860- First true bicycle invented by Ernest Michaux and Pierre Lallement, known as the velocipede
1861- Included crank and pedals but not yet brakes, resulting in many dangerous "headers"

1870- Penny Farthing bicycle invented. The name came from the idea that the wheels resembled two coins, the penny and the farthing next to each other, the former significantly larger than the latter. It was unstable, extremely difficult to get on and off and the front wheel was used for power and steering. Considering, it was not an ideal or efficient machine.

1885- safety bicycle invented by John Kemp Starley characterized by two wheels of the same size and a rear wheel connected and driven by a chain. This made for a more efficient bicycle that could use smaller wheels. This invention was named for the obvious reason that it was safer than the penny-farthing because of the lower centre of gravity.

1894- Betty Bloomers became popular. Women were no longer limited to tricycles and could ride comfortably in their long skirts

1903- Internal hub gears invented 1920- The Kids Bike invented. This design, weighing in at around 65 pounds, mimicked aspects of the motor vehicle as the automobile became more desirable than bikes.1930- Schwinn adds spring fork and fat tire to handle the abuse of teenage boys. This later became the preliminary design for the mountain bike.

2000- Electric bike. History of bicycle data is taken from URL:https://www.brown.edu/Departments/Joukowsky_Institute/courses/13things/7083.html

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